Final Report for Grant # N00014-91-5-1741

A Physical Process Study for the North Atlantic Current System

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The objectives of Grant # N00014-91-5-1741 were to gain a better understanding of how atmospheric forcing influences the Gulf Stream - North Atlantic Current system and the communication between the subtropical and subpolar gyres. This work resulted in the publication of two manuscripts in refereed journals and five oral presentations. The first study, "A Diagnostic Study of the Wind- and Buoyancy-Driven North Atlantic Circulation, *J. Geophys. Res.*, **96,** 18509-18518 by M. A. Spall, addresses the combined influences of wind and buoyancy forcing on the large scale climatological circulation in the North Atlantic. The results indicate that the pumping of mass down from the mixed layer into the main thermocline is controlled by both large scale Ekman convergence and horizontal variations in mixed layer depth. Furthermore, nonlinear terms in the potential vorticity equation are required to balance heating in the subtropical gyre and cooling in the western boundary current and northern recirculation regions.

The second paper, "Cooling Spirals and Recirculation in the Subtropical Gyre", *J. Phys. Oceanogr.*, **22,** 564-571, by M. A. Spall, investigates the influences of heat loss in the Gulf Stream on the local velocity and density structure, and the influences of these local changes on the large scale recirculation of water masses and the exchange between the subtropical and subpolar gyres. It was found that heat loss in the western boundary current extension forces a rotation of the velocity vector with depth consistent with potential vorticity constraints. Each pass through this cooling spiral forces the water parcels to recirculate on deeper density surfaces in an ever increasing horizontal scale, resulting in an exchange of mass between the subtropical and subpolar gyres.